REMARKS

In paragraph 1 of the office action the drawing is objected to for various reasons . Responsive thereto, applicant has amended Figs. 1-4 of the drawing to comply with the corrections described therein, and marked up drawings are included herewith. Additionally, applicant has amended the specification to refer to the NiFe film with number 86 . Applicant therefore respectfully submits that this ground of objection has been satisfied.

In paragraph 2 of the office action the word "permalloy" is identified as a trademark and certain corrections to the specification are requested. Responsive thereto applicant respectfully traverses this ground of objection. Specifically, applicant notes that the word "permalloy" is not a US registered trademark for nickel-iron compounds, although it is a registered trademark for other goods or services. Applicant has used the word "permalloy" as the well known generic term for nickel-iron compounds as would be well understood by those skilled in the art. Applicant therefore respectfully submits that no correction to the specification is required with regard to applicant's usage of the word "permalloy", and it is respectfully requested that this ground of objection be withdrawn.

In paragraph 3 of the Office Action the disclosure is objected to, stating:

> "The disclosure is objected to because of the following informalities:
> page 6, line 1 - "steep angle 60" redefines "60" which was used previously (page 5, line 21) in reference to the etchant species;
> page 6, line 1 - "alumna" should be --alumina--;
> Page 7, line 9, reference number "64" is used with reference to the C2F6/Ar beam whereas previously (page 6, line 1) "64" was used in reference to an angle;
> Appropriate correction is required."

Responsive thereto, applicant has amended the specification to correct the objected to informalities. Applicant therefore respectfully submits that this ground of objection has been satisfied.

In paragraph 4 of the office action portions of claims 3 and 7 are objected to. Responsive thereto, applicant notes that claims 3 and 7 have been deleted in this amendment. Therefore, this ground of objection has been satisfied.

In paragraphs 5 and 6 of the Office Action claims 1, 8 and 18, and thereupon dependent claims 2-7 and 8-17, are rejected under 35 U.S.C. 112, first paragraph, stating:

> "because the specification, while being enabling for steps pertaining to the etching of the write gap layer and underlying pole layer, does not reasonably provide enablement for "conducting further steps to complete the fabrication of said magnetic head. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims. The specification provides no information pertaining to the further steps that are required to complete the fabrication of the magnetic head."

Responsive thereto, applicant notes that claims 1 - 7 and 12 have been deleted without prejudice in this amendment. With regard to claims 8 - 18, applicant has amended independent claims 8 and 18 to delete the reference to "further steps". Applicant therefore respectfully submits that this ground of rejection has been satisfied.

In paragraphs 7 and 8 of the Office Action claims 1 and 2 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,316,617 issued to Kawabe et al. (hereinafter, Kawabe), stating:

> "Kawabe teaches the use of C2F6 to etch the alumina gap layer of a magnetic head and subsequently etching the underlying magnetic (pole) layer with an argon ion beam (column 8, line 58 column 9, line 45)."

Responsive thereto, applicant notes that claims 1 and 2 have been deleted without prejudice in this amendment. Applicant therefore respectfully submits that this ground of rejection has been satisfied.

In paragraph 9 of the Office Action claims 1-3, 7 and 8 and rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 6,238,582 issued to Williams et al. (hereinafter, Williams), stating:

> "Williams teaches a method if making a magnetic head in which the write gap layer is etched by an ion bean generated from a mixture of C2F6 and Ar and then argon is used to etch the underlying magnetic pole layer (column 8, line 36 - column 9, line 33)."

Responsive thereto, applicant notes that claims 1 - 3 and 7 have been deleted in this amendment. With regard to claim 8, applicant has amended it to include two ion beam etchant steps, and to include limitations previously set forth in claim 12, and has also included new limitations regarding the P1 pole first etchant ion beam angle and second P1 pole etchant ion beam angle. Applicant therefore respectfully submits that this ground of rejection of claim eight under 35 USC 102(e) has been satisfied. Applicant notes that dependent claim 12 has been rejected in paragraph 10 and 11 of the office action, and a discussion related thereto is set forth nextbelow.

In paragraphs 10 and 11 of the Office Action claims 4-6 and 9-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Williams, stating:

> "Williams teaches the limitations of independent claims 1 and 8 as noted above. Williams teaches and claims that any one of six specific fluorocarbons, including C2F6 and CHF3, can be used to etch the gap layer. Williams teaches using 75% fluorocarbon in a fluorocarbon/Ar etchant mixture (column 8, line 59). Williams teaches etching the write gap layer using a first ion beam angle of about 10° (0° - 20° column 8, line 40) followed with a side wall cleanup step using an angle of 60° - 90°. Williams teaches using a beam voltage of 700 V with a beam current of 1100 mA (column 11, line 67).
>
> Williams does explicitly teach not teach the fluorocarbon concentration, the ion beam angle, the ion beam voltage or ion beam current, when the fluorocarbon is C2F6.
>
> When substituting C2F6 for CHF3, it would have been obvious to one skilled in the art to use a C2F6 concentration, as well as the beam voltage, current and angles that Williams taught when CHF3 was used as the fluorocarbon etchant because Williams teaches the C2F6 may be substituted for CHF3. Williams is silent with regard to the specific values of these parameters when using a fluorocarbon other than the CHF3 that was used in the examples of Williams.

Therefore, it would be obvious to use the same process conditions when substituting one functionally equivalent fluorocarbon for another because Williams does not teach or suggest that any of these parameters should be changed when one functionally equivalent fluorocarbon is substituted for another.

Additionally, it is noted that Williams does not teach a Ni fluoride film is formed on the upper pole when the write gap layer is being etched. However, as Applicant and Williams use the same etchant to etch the same material under the same conditions, the claimed Ni fluoride film would inherently be present in the method of Williams."

Responsive thereto, applicant notes that claims 4-6 and 12 have been deleted without prejudice in this amendment, and that claims 8-11 and 13-18, as amended, remain, and that new claims 19-21 have been added. In this amendment, independent claims 8 and 18 have been amended to more clearly recite applicants invention and to distinguish it from the teachings of Williams, as is next discussed.

Williams teaches a process that is essentially described in the background of applicant's specification, and applicant's invention is an improvement over the teachings of Williams. Specifically, Williams teaches a reactive ion etch process in which CHF3 plus argon is used as the RIE input gas to produce reactive species for etching alumina (the write gap). But as is pointed out in applicant's specification, and also pointed out in Williams, the use of CHF3 creates unwanted polymer deposits upon the surface of the wafer. Williams teaches that the solution to this problem is to utilize an intermediate oxidizing etching step using oxygen plus argon (or other oxidizing species) to remove the polymer deposit. Following this oxidizing RIE cleanup step, Williams then teaches the use of argon in an ion beam etching step to notch the permalloy (NiFe) P1 pole. Therefore, Williams teaches a three step ion beam etching process in which CHF3 plus argon are used in the first RIE step, oxygen plus argon are used in the second RIE step, and argon is used in the third ion beam etching step.

Applicant's process is an improvement upon Williams in that it is a two step ion beam etching process; specifically, a first RIE step using C2F6 plus argon to etch the alumina write gap layer, followed by the second ion beam etching step using argon to etch the permalloy P1 pole. This improvement, as described in the specification, is a result of applicant's discovery that RIE using C2F6 plus argon does not create unwanted polymer deposits which require a removal step, such as Williams intermediate RIE step utilizing oxygen plus argon.

Therefore, in applicant's amendments to independent claims 8 and 18, applicant has distinguished Williams teachings by limiting applicant's process to the two ion beam etching steps. Essentially, while Williams identifies C2F6 among other possible substitute gases for CHF3, as is pointed out in the office action rejection, Williams does not teach nor render obvious that the use of C2F6 can result in the removal of an entire process step (the oxygen plus argon second RIE etching step to remove unwanted polymer deposits) as is taught and claimed in applicant's specification and amended independent claims 8 and 18. With regard to dependent claims 9-11 and 13-17 and new claims 19-21, applicant further submits that the limitations set forth in these dependent claims, in combination with the limitations set forth in amended independent claims 8 and 18, set forth nonobvious combinations of limitations, and alternatively that these claims are allowable as being dependent from allowable base claims. Applicant therefore respectfully submits that amended independent claims 8 and 18, as well as claims dependent therefrom, recite subject matter that is not obvious from the teachings of Williams, whereby this ground of rejection has been satisfied.

In paragraph 12 of the office action further prior art is made of record, with an indication that the references could be cited in a section 102 or 103 rejection of the original claims. Responsive thereto, applicant has reviewed this art with regard to the amendments to

independent claims 8 and 18 as discussed above. Upon review, applicant believes that the teachings of these references are generally not as close to the present invention as are the teachings of Williams (discussed above), and that the teachings are generally cumulative to the teachings of Williams. Specifically, none of these references teaches a two step ion beam etching process for a P1 pole utilizing C2F6 plus argon in a first alumina write gap RIE step and argon in a second permalloy ion beam etching step. Therefore, applicant respectfully submits that the claims, as amended, recite subject matter that is patentable over the teachings of the references cited in paragraph 12 of the office action.

Having responded to all of the paragraphs of the office action, and having amended the claims accordingly, applicant respectfully submits that the claims, as amended, recite subject matter that is neither taught by nor obvious from the cited prior art. Applicant therefore respectfully submits that the application has been put into condition for allowance, and applicant respectfully requests that a notice of allowance be forthcoming at the examiner's earliest opportunity. Should the examiner have any questions or comments with regard to these remarks, a telephonic conference at the number set forth below is respectfully requested.

Respectfully submitted,

Dated: May 21, 2002

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CERTIFICATE OF MAILING (37 CFR 1.8(a))

I hereby certify that this paper (along with any referred to as being attached or enclosed) is being deposited on May 21, 2002 with the U.S. Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, Washington, D.C., 20231.

Date: May 21, 2002

Patricia Beilmann

ATTACHMENT A

MARKED UP SPECIFICATION PARAGRAPHS

Page 5, Line 19 - Page 6, Line 16

The present invention involves the use of C_2F_6 gas in place of the CHF_3 as a first etchant gas in a two-step P1 notching process. As depicted in Fig. 3, in using a combination of C_2F_6 and argon (designated herein as C_2F_6/Ar) as a first etchant gas, etchant species [60] are created that selectively etch the alumina write gap layer preferentially over the NiFe P2 pole tip material. As described in detail hereinbelow, the ion beam of C_2F_6/Ar etchant gas is preferably directed at a relatively steep angle 60 and subsequently at a relatively shallow angle 64. After the [alumna] alumina write gap layer has been etched using C_2F_6/Ar to form notches 66 through the alumina layer 18, argon gas is substituted for the C_2F_6/Ar in order to form etchant species that are also directed at a relatively steep angle 80 and subsequently at a relatively shallow angle 82 to form notches 84 in the P1 pole 14 as is depicted in Fig. 4.

Significantly, the use of C_2F_6 as an etchant gas creates fewer organic polymer contaminants than are seen with the prior art CHF_3 etchant gas. Thus, reduced cleaning and maintenance of tooling hardware is required. Additionally, it has been unexpectedly found that exposing NiFe to fluorine ion containing species, such as those generated in the C_2F_6 gas chemistry results in the formation of a beneficial Ni fluoride compound thin film layer on the surface of the P2 pole tip. Specifically, the Ni fluoride thin film [88] 86 on the surface of the P2 pole tip apparently provides a protective layer that is more slowly etched by the argon etchant species than an unprotected NiFe P2 pole tip. This is in contrast to that which is found in the prior art CHF_3 etchant gas process, in which a polymer layer is formed to slow down the NiFe etching. Thus, the use of the C_2F_6 etchant gas also provides some protection for the P2 pole tip during the second step of the P1 layer notching with the argon etchant gas species.

Page 6, Line 22 - Page 7, Line 12

There are two objectives in the write gap layer etching step; the first objective is to remove the write gap layer material, and the second objective is to remove any write gap layer redeposition material that is accumulated on the sidewalls of the P2 pole tip. As shown in Fig. 3, for write gap layer material removal, the incident angle i from the normal to the substrate surface of the C_2F_6/Ar beam [60] is selected to be greater than the P2 pole slanting angle s, from the normal to the substrate surface. As is known to those skilled in the art, the angle s results from the P2 pole plating process conditions. Thus, where angle i is greater than angle s the shadowing of the P2 pole base by the P2 pole top is avoided. For example, if the slanting angle s is 5°, the incident angle i should be 10° or greater. In general, the angle i should be in the range of 5 - 30°, with a more preferred range of 10-20°. For removal of redeposition material from the sidewalls of the P2 pole tip structure, the incident angle i of the C_2F_6/Ar beam [64] is chosen to be in the range of 65-80°, with a preferred range of 70-75°. Because of the good etching selectivity of Al_2O_3 over NiFe, this P2 pole tip sidewall cleaning step will not alter the P2 pole tip track width even if an aggressive overetch is applied.

ATTACHMENT B

MARKED UP VERSION OF AMENDED CLAIMS

8. (Once amended) A method for fabricating a magnetic head, including the steps of:

fabricating [portions of said magnetic head including] a P1 pole, a write gap layer and a P2 pole tip;

notching said P1 pole using two ion beam etching steps including [the following steps]:

etching portions of said write gap layer utilizing [an] a write gap etchant ion beam that is formed [with] from an etchant gas including C_2F_6 and argon, wherein said etching of said write gap layer is conducted in part with a first write gap etchant ion beam angle away from normal of from 5° to 30°, and in part with a second write gap etchant ion beam angle away from normal of from 65° to 85°;

subsequently etching portions of said P1 pole using a P1 pole etchant ion beam that is formed using argon as an etchant gas, wherein said etching of said P1 pole is conducted in part with a first P1 pole etchant ion beam angle away from normal of from 30° to 45°, and in part with a second P1 pole etchant ion beam angle away from normal of from 65° to 85°[; and

conducting further fabrication steps to complete the fabrication of said magnetic head].

13. (Once amended) A method for fabricating a magnetic head as described in claim [12] 8 wherein said first write gap etchant ion beam angle is from 10° to 20° and said second write gap etchant ion beam angle is from 70° to 75°.

14. (Once amended) A method for fabricating a magnetic head as described in claim 13

wherein said first write gap etchant ion beam angle is approximately 10°.

15. (Once amended) A method for fabricating a magnetic head as described in claim [12] 13 wherein said C_2F_6 /Ar ion beam is generated with an ion beam voltage of from 600-900 volts, and an ion beam current of from 600-1200 mA.

16. (Once amended) A method for fabricating a magnetic head as described in claim 15 wherein said C_2F_6/Ar ion beam voltage is in the range of 650-750 volts and said ion beam current is in the range of 900-1100 mA.

17. (Once amended) A method for fabricating a magnetic head as described in claim [15] 16 wherein a Ni fluoride thin film layer is formed on said P2 pole tip.

18. (Once amended) A method for fabricating a magnetic head, including the steps of:

fabricating [portions of said magnetic head including] a P1 pole, a write gap layer and a P2 pole tip;

notching said P1 pole [including] in a process consisting essentially of the following two etching steps:

etching portions of said write gap layer utilizing [an] a write gap etchant ion beam that is formed [with] from an etchant gas including C_2F_6 and argon, wherein said C_2F_6 gas concentration range is from 70% to 80%; and wherein said etching of said write gap layer is conducted in part with a first write gap etchant ion beam angle away from normal of from [5° to

30°] 10° to 20°, and in part with a second write gap etchant ion beam angle away from normal of from [65° to 85°] 70° to 75°;

subsequently etching portions of said P1 pole using a P1 pole etchant ion beam that is formed from argon as an etchant gas, wherein said etching of said P1 pole is conducted in part with a first P1 pole etchant ion beam angle away from normal of from 30° to 45°, and in part with a second P1 pole etchant ion beam angle away from normal of from 65° to 85° [; and

conducting further fabrication steps to complete the fabrication of said magnetic head].